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Integration of geological, geophysical and seismological data to justify the seismic source zone model

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The probabilistic method for seismic hazard assessment (PSHA) is one of the most preferred today. It is flexible, and takes into account as much data as you can collect. Undoubtedly, the earthquake catalogue is first of all but often is too short to show all the sorts of earthquakes that might happen in the future. It is therefore necessary to make a number of interpretative decisions based on integration of geological, geophysical and seismological data in order to build up the initial seismic source zone model. Recent papers have emphasized the importance of integrating and processing different geodatasets which are connected to the possible sources of earthquakes. Our study presents the results from calculation of a specially derived numeric parameter which shows the existence or not of a match in the spatial manifestation of any two features (characteristics) regardless their type or units of measure.

The territory of Bulgaria, located in the seismically active region of the Balkans, requires a very thorough analysis of the information when performing PSHA. In 2018, we used the opportunity to test the applicability of our spatial matching index (SMI) performed in GIS for integration of different types of data. During the last two decades a number of high quality geological, geophysical and seismological data were collected and we used them for the purposes of seismic hazard assessment. The algorithm of the spatial matching index (SMI) calculation was used to define the coincidence of independent information showing any indications for existence of a fault structure. It was applied for evaluation of the seismic potential of 416 square blocks, 20x20 km in size covering the entire territory of Bulgaria and extended by 20 km outside of the country borders. All operations were carried out in GIS environment using its capabilities to work with different types of georeferenced spatial data. Results show that the highest seismic potential (largest SMI) is observed in 56 block elements (13% of the territory). Expected, those are the regions near Varna, Dulovo, V. Tarnovo, Sofia, Plovdiv, Krupnik and some other places possessing a full set of studied characteristics. Partial match is registered in 98 block elements when one of the features is missing. Not any evidence for earthquake occurrence is predicted by our calculation in 117 elements, comprising 28% of the examined area.

The proper integration of large amounts of data (geological, geophysical and seismological) was used to justify the seismotectonic model thus increasing the power of the PSHA method.